

The Subterranean Amphipoda of the British Isles. By CHARLES CHILTON, M.A., D.Sc., F.L.S., Research Fellow, University of Edinburgh.

[Read 21st June, 1900.]

(PLATES 16-18.)

ALTHOUGH the first subterranean Amphipod that was definitely recognized and described as such was a British species, and although the different species known at the time were described and figured in some detail by Spence Bate and Westwood in 1863 [1. pp. 311 to 328]*, very little has been published on the group by subsequent British writers, though on the Continent several important papers dealing with the subject have appeared. These Amphipods are known to be widely distributed in the southern parts of England and they have been also recorded from Dublin, and, judging from experience in other countries, they are probably fairly abundant; but at the same time it is by no means easy to obtain specimens, for they are either altogether overlooked by the ordinary householder, or, if they are seen, their presence is, as Mr. Stebbing [2. p. 30] has pointed out, kept a secret from the fear that the well may otherwise be closed by the sanitary authorities. There are several points that are still uncertain with regard to the number and distribution of the British species, and in the course of a wider study of subterranean Crustacea I was anxious to solve these so far as possible, and to attract fresh attention to the subject in the hope that further knowledge might be obtained upon it. This paper is the result of the work that I have been able to do on the subject; but though various friends have generously supplied me with all their available material, I regret that the results must seem somewhat meagre, and that I am not able to add very much to the information given many years ago by Spence Bate. However, I give fuller details of some of the species and revise the nomenclature, after comparison with some of the European species. I also give a very short sketch of the growth of our knowledge on the subject, and some brief notes on the distribution of the British species.

* The numbers in square brackets refer to the list of references at the end of the paper.

For supplying me with material I desire to record my best thanks to the Rev. T. R. R. Stebbing, who has very kindly placed the whole of his specimens of the group at my disposal, to Professor D'Arcy W. Thompson, C.B., of University College, Dundee, to Dr. R. T. Scharff of Dublin, and to Dr. S. F. Harmer of Cambridge. Monsieur Edouard Chevreux of Bône, Algeria, and Professor Franz Vejdovsky of Prague have given me specimens from some localities on the Continent that have been most useful for the purpose of comparison.

Historical.

The first mention of subterranean Crustacea in the British Isles was made by Leach [3. p. 403] in the article "Crustaceology" in the 'Edinburgh Encyclopædia,' published probably in 1813 or 1814. His specimen came from a well in London, and was by him distinguished from *Gammarus pulex* under the name *G. subterraneus*. His description is very brief and insufficient, but from what he says it is, I think, evident that the specimen must have belonged to the genus now known as *Niphargus*; and from our present knowledge of the distribution and occurrence of the species of this genus, it is perhaps not unreasonable to suppose that it was the species which is most commonly found and which has long been known in England by the name *Niphargus aquilex*, Schiödte, and I have accordingly in this paper followed Della Valle in adopting Leach's name for this species. Spence Bate and Westwood give Leach's species as a synonym of *N. aquilex*, though retaining the later name of the species [1. p. 314].

For many years nothing appeared on the subject in England, though on the Continent species of subterranean Amphipods were described by Gervais [4. p. 127], Koch [5], Schiödte [8], Caspary [6], Hosius [7], &c., and in 1851 the genus *Niphargus* was established by Schiödte.

In 1853 a subterranean Amphipod was found by J. O. Westwood at Maidenhead [9. p. 218]; this was at first referred to *N. stygius*, Schiödte, but was shortly afterwards described as a separate species, *N. aquilex*, by Schiödte. This species was accepted as a good one by Spence Bate and Westwood, though on different grounds from those relied upon by Schiödte in defining the species. Adam White, in his 'Popular History

of the British Crustacea' [10], gave the species under the name *Niphargus aquilex*, Schiödte, and suggested that it was the same as *Gammarus subterraneus*, Leach. Some account of it was given anonymously in the 'Natural History Review' in 1857.

In 1859 Spence Bate [11] described two new species of *Niphargus*, viz. *N. fontanus* and *N. Kochianus*, and also established the new genus *Crangonyx* for another species, *C. subterraneus*, found by the Rev. H. R. Hogan at Ringwood. In the same year Hogan gave some account of the habits, food-supply, &c. of these three species [12. pp. 166-169].

All the British subterranean species were given by Spence Bate in the 'Catalogue of the Amphipoda in the British Museum' in 1862 [13. pp. 174 &c.], and afterwards by Bate & Westwood in their 'History of the British Sessile-eyed Crustacea,' where full descriptions are given and some general remarks are made on their affinities, habits, distribution, &c. [1. pp. 311 to 328].

I do not know of any further work in English specially dealing with these Crustacea, though naturally they have frequently been referred to in some of the numerous works dealing with the similar forms found in other countries; some remarks upon them are made too by Stebbing in the course of the Bibliographical Introduction to his "Report on the 'Challenger' Amphipoda."

Quite recently a species of *Niphargus* has been recorded from Cringleford, near Norwich, by Dr. S. F. Harmer [14. pp. 489-491]; and the Rev. T. R. R. Stebbing [2] has drawn attention to the whole subject of the British subterranean fauna in his address to the Associated Societies at the Dover Meeting of the British Association.

Of the writers on European species it will be sufficient to mention the names of Valette St. George [15]; Joseph [16]; de Rougemont [17], whose papers led to so much controversy; Humbert [18], who described a variety of *Niphargus puteanus*, Koch, with an accuracy and fullness of detail that has scarcely been equalled since; Moniez [19]; and Wrzesniowski [20], in whose paper a full historical account of the subject will be found.

More recently Chevreux [22] has described a new species of *Niphargus* from France, Vejdovsky has published valuable papers

on *Crangonyx* [21] and on the rudimentary eyes of *Niphargus* [34], and Armand Viré [23] deals with two species of the latter genus in his work 'La Faune souterraine de France,' issued during the present year.

In North America several similar Amphipods have been discovered and have been described by Cope [24], Packard [25], Forbes [27], Benedict [26], &c.; full information of the cave-fauna of North America will be found in Packard's larger memoir published in 1888, and he has rediscussed some of the theoretical bearings of the facts in a subsequent paper [35].

The New-Zealand forms first recorded by me in 1881 and 1882 are fully described in my paper in the 'Transactions of the Linnean Society' in 1894 [28. pp. 163-284]. Closely allied Amphipods, but with normal eyes, were described from Tasmania by G. M. Thomson in 1892 [29]; and within the last year a blind species of *Niphargus* has been found by O. A. Sayce in Gippsland, Victoria, Australia [30. pp. 152-159].

Distribution of the British Species.

Owing to the isolated localities in which they are found and to the fact that specimens have fallen into the hands of many different observers, a large number of species of *Niphargus* has already been described, some of them probably on insufficient grounds. In his revision of the genus in 1890 Wrześniowski gives a list of 14 species, six, however, he marks as doubtful; and Stebbing [31. p. 425] has since suggested that one of these, *Niphargus Moniezi*, may perhaps more appropriately find a place under *Neoniphargus*. On the other hand, Chevreux has recently described a new species, *N. Virei*, from the grottos of the Jura and tells me by letter that he has other new species to describe. Other writers, such as de Rougemont and Della Valle, again, have supposed that the different species described are merely forms of one wide-spread species, and have caused great confusion by reducing them all to synonyms of *Niphargus puteanus*, Koch. The latest effort of this kind is that of Hamann [33. p. 234], who recognizes neither *Niphargus* nor *Crangonyx*, and classes all the subterranean Amphipods of Europe under *Gammarus puteanus*, Koch. It is almost incredible that he should come to this conclusion after avowedly studying Wrześniowski's work, and it will be evident to all that he has quite failed to appreciate

the careful observations of the latter, and his view that *all* the recorded species are forms of one cannot be for a moment accepted.

Fortunately there is no great difficulty in identifying our British species. Besides *Niphargus fontanus*, which I have not seen, we have three species. The first, *N. subterraneus*, Leach, is known from many districts in the Southern Counties of England and as far north as Norwich; it has not been recorded from Scotland nor Ireland; Mr. Thomas Scott tells me that he has frequently sought for subterranean crustaceans from wells near Edinburgh without success, and I have not been able to hear of them in any part of Scotland, though I have made frequent inquiries; neither could it be found in the Irish caves investigated by Carpenter and others, though it had been specially looked for years before by Wright and Halliday [36. p. 26]. In Europe the species is very widely distributed and has been recorded from many localities in France, Austria, Bohemia, Germany, Poland, &c.

The second species, *N. Kochianus*, Spence Bate, has been recorded from several localities in the South of England, and is also found in Ireland at Dublin. In Europe it is so far known from Munich only, though it is doubtless to be found at other places; and it seems probable that *N. puteanus*, described by Hosijs from Bonn, is the same species.

The third species, *Crangonyx subterraneus*, Spence Bate, is known in England only from Ringwood and Marlborough and appears to be rare, for in each case only a single specimen was obtained. In Europe a few specimens have been recorded from Radotin near Prague by Vejdovsky, and many years previously it was taken at Munich by de Rougemont.

From this it appears that, with the exception of *N. fontanus*, which is as yet known only from Spence Bate's description, all the British forms belong to species widely distributed in Europe.

Genus NIPHARGUS, *Schiödte*.

1851. *Niphargus*, Schiödte, Det danske Videnskabernes-Selskabs Skrifter, 5e Raekke. Naturvidenskabelig og Mathematisk Afdeling, Bd. ii. p. 26.

The genus *Niphargus* was established by Schiödte in 1851 for the reception of some subterranean Amphipoda and was accepted

by Spence Bate & Westwood, who gave a fuller diagnosis in 1863 [1. p. 311]; in 1876 Humbert gave a still fuller description [18. p. 312]; and more recently Wrześniowski [20. p. 620] has given a full critical history and account of the genus, followed by a Latin diagnosis, of which I give a translation here:—

“Eyes none (or rudimentary).

“Body compressed, not carinate. Fourth and fifth segments of the pleon bearing slender setules. Epimera small.

“Superior antennæ longer than the inferior, with a secondary appendage of not more than two joints; primary flagellum bearing olfactory setæ and hyaline bacilli. Flagellum of inferior antennæ in both sexes bearing only hyaline bacilli.

“Gnathopoda similar, subchelate, with the penultimate joint (propodos) dilated, of nearly the same form in both sexes.

“Terminal uropoda biramous, inner ramus very small, outer ramus elongate, two-jointed (or one-jointed?).

“Telson more or less deeply cleft.

“Molar tubercle of the mandibles supplied with a long seta; palp narrow, three-jointed.

“First maxillæ furnished with forked spines; palp large, two-jointed, of the same form in the right and left maxillæ, armed at the apex with spines and setæ; inner lobe narrow, bearing only two or three setæ at the apex.

“Second maxilla with the inner lobe bearing setæ at the apex only.

“Outer lobe of the maxillipedes armed on its inner margin with teeth, at the apex with teeth and strong setæ; inner lobe armed at the apex with three strong teeth and a very few setæ, the inner margin destitute of setæ; palp elongate, the last joint very narrow towards the apex, unguiform.”

This is rather a long and unwieldy generic description, and no doubt the diagnosis could be considerably curtailed if *Niphargus* were compared with allied genera and the characters common to several genera carefully eliminated; and this will I hope be done by the Rev. T. R. R. Stebbing in his account of the Amphipoda prepared for ‘Das Tierreich.’ In his paper on new genera of the Gammaridæ already published [31] he does not give revised diagnoses of the genera previously known, but among the new genera he gives one, *Neoniphargus*, which appears to come very close to *Niphargus*, the only important difference being that in

it the third uropoda are not elongate and their outer branch consists of one joint only.

The affinities of *Niphargus* were fully discussed by Wrzeńskiowski in 1890, and in the present state of our knowledge it does not appear possible to add very much to what he then said. Its nearest allies seem to be the *Neoniphargus* already mentioned and *Crangonyx*, with the genera *Paracrangonyx* and *Eucrangonyx* lately established by Stebbing, while the little-known marine genus *Eriopsis* also seems to be nearly related. Naturally enough it has frequently been compared with *Gammarus*, since freshwater species of this genus are often present in the districts where the subterranean *Niphargi* are found. Wrzeńskiowski has pointed out that most of the external characters of *Niphargus* are shared by various species of *Gammarus*, and that consequently these alone are not sufficient to distinguish the two genera; he has, however, shown that there are important differences in the mouth-parts, and these he has described in great detail. Although there are considerable differences between the mouth-parts of a typical *Gammarus* and a typical *Niphargus*, there are already known some intermediate species, and no doubt others will hereafter be described which will still further bridge over the gap between the two. Some of the numerous species from Lake Baikal referred to *Gammarus* by Dybowski present external resemblances to *Niphargus*; but although many of them have been assigned to new genera by Stebbing, no satisfactory account of their mouth-parts has as yet been published, and without this it would be useless to attempt any detailed comparison. In his account of the genus *Crangonyx* Professor Vejdovsky has drawn special attention to the sensory setæ found on various parts of the body and appendages; and he tells me that in these and also in some parts of the internal anatomy, especially in connection with the renal gland in the base of the lower antennæ, he has found good points of difference not only between allied genera such as *Gammarus*, *Niphargus*, and *Crangonyx*, but in some cases even between different species of the same genus—a paper dealing with these points will shortly be published by him. It is unfortunate that most of these characters, important as they are, can be observed only in fresh specimens or require to be elucidated by the cutting of serial sections, and that consequently they have been and, to a large extent, probably will continue to be neglected by the systematist.

NIPHARGUS SUBTERRANEUS, *Leach*. (Plates 16 and 17. fig. 1.)

1814. *Gammarus subterraneus*, Leach, Edinburgh Encyclopædia, vol. vii. p. 403.
- 1841-4. *Gammarus puteanus*, Koch, Deutschlands Crustaceen, Myriapoden und Arachniden, Heft 36, Taf. xxii.
1853. *Niphargus stygius*, Westwood, Proc. Linn. Soc., No. li. p. 218.
 " " Spence Bate, Ann. & Mag. N. H. ser. 2, xix. p. 146.
1855. *Niphargus aquilex*, Schiödte, Oversigt over det Kg. Danske Vidensk.-Selskabs Forhandlinger, 1855, pp. 349-351; also in Nat. Hist. Review, i. p. 41, fig. B.
1857. *Niphargus aquilex*, White, Popular History of British Crustacea, p. 187.
1857. *Gammarus puteanus*, La Valette St. George, "De Gammaro puteano," Dissertatio Inauguralis, 1857.
1862. *Niphargus stygius*, Spence Bate, Cat. Amphip. Brit. Mus. p. 174, pl. xxxii. fig. 1.
1863. *Niphargus aquilex*, Spence Bate & Westwood, Brit. Sessile-eyed Crust. i. p. 315.
1888. *Niphargus aquilex*, Stebbing, Report on the 'Challenger' Amphipoda, p. 316.
1889. *Gammarus puteanus* ("à main triangulaire"), Moniez, Rev. Biol. du Nord de la France, i. pp. 41-46.
1890. *Niphargus puteanus*, Wrześniowski, Zeitschrift für wissenschaftliche Zoologie, L. 4, p. 673.
1893. *Niphargus subterraneus*, Della Valle, Gammarini del Golfo di Napoli, p. 704 (*in part*).
1896. *Gammarus puteanus*, Hamann, Europäische Höhlenfauna, Jena, p. 234 (*in part*).
1899. *Niphargus aquilex*, Harmer, Trans. Norfolk & Norwich Naturalists' Society, vol. vi. pp. 489-491.
1900. *Niphargus puteanus*, Armand Viré, Faune souterraine de France, p. 34 &c.

Specific diagnosis.—Body slender, first four side-plates not so deep as their respective segments; postero-inferior angles of the first three segments of the pleon broadly rounded.

Superior antennæ half as long as the body; flagellum of about 20 joints, rather more than one and a half times the length of the peduncle; secondary appendage of two joints, shorter than the first two joints of the main flagellum. Inferior antenna with the flagellum of 7 to 9 joints.

Maxillipedes with the lobes small, inner lobe reaching only to the end of the inner margin of the meros, and outer lobe reaching only halfway along the inner margin of the carpus.

First gnathopod with the basos very broad, the width at the distal end in the male being fully one-half the length: ischium and meros both short and subquadrate and of about equal size; meros with its distal border fringed with a row of long setæ, of which one is much longer than the others and is finely barbed, curved, and reaches about as far as the end of the propodos; greatest length of the carpus considerably less than that of the propodos; extremity very oblique and nearly all occupied by the articulation of the propodos, so that the posterior border is very short; a tuft of setæ at the antero-distal angle, and a row along the outer edge of the short posterior border, on the inner surface is a row of about seven long setæ along the half of the oblique extremity nearest to the posterior border: propodos large, subtriangular, broadest distally where the breadth is slightly greater than the length of the anterior border: palm transverse, straight or slightly convex; anterior border with a tuft of about six setæ at base of dactylos, and a smaller tuft situated a little proximally to this; the posterior border bears six short transverse rows of setæ; palm defined by a stout spine, and near it two smaller spines coarsely serrated, along the palm is a row of short setæ, with one or two longer ones at intervals: dactylos fitting closely on to the palm, terminal claw very acute, secondary claw distinct and sharp with a short seta at its base, outer border convex and bearing only one seta opposite the base of the secondary claw.

Second gnathopod slightly larger than the first, but very similar in form: basos not so broad, the greatest breadth being rather less than half the length; ischium and meros similar to those of the first gnathopod, but the meros without the large curved seta; carpus as long as the propodos, rather more slender than in the first gnathopod, the posterior surface longer and slightly concave for the reception of the base of the propodos, both edges bearing a row of setæ; propodos as in the first gnathopod, but with the breadth at distal end distinctly greater than the length of the anterior border; posterior border very convex and with nine rows of setæ; dactylos as in first gnathopod.

First and second pereopoda equal in length, third slightly longer, fourth and fifth each distinctly longer than the one immediately preceding. Basa of third, fourth, and fifth pereopoda rather narrow, the greatest breadth being rather more than one-half of the length.

Terminal uropoda in the fully-grown male nearly one-half the length of the body; outer ramus of two subequal joints, the first with four tufts of setæ, the terminal one nearly free from setæ, except a small tuft at the apex. In the female the terminal uropoda one-fourth the length of the body, and the last joint of outer ramus only about one-third of the first.

Telson reaching to the end of the peduncle of the third uropoda, split to more than half its length, each lobe narrowing towards the apex, which bears three stout setæ; outer margin convex, and with two fine setæ a little anterior to the apex.

Length of fully-grown specimens about 11 mm.

Habitat. Southern Counties of England; (Europe generally).

The above description will, I hope, be sufficient for the identification of this species. A much more detailed description is given by Humbert of *Niphargus puteanus* var. *Forelii*, from Lake Geneva. Wrześniowski indeed thinks this form sufficiently distinct to rank as a separate species, *N. Forelii*; but though he is perhaps right, the differences are very slight. Wrześniowski's full description of *Niphargus puteanus* var. *Vejdovskyi* may also be consulted.

The points chiefly relied upon by Wrześniowski for the separation of the different species of *Niphargus* are the lengths of the antennæ and terminal uropoda in proportion to the body, the depth of the side-plates, the relative lengths of the pereopoda, the shape of the propoda of the gnathopoda and of the lower margins and angles of the first three segments of the pleon, and the relative lengths of the two joints of the outer ramus of the third uropod. These points he found to be fairly constant in specimens of different ages from the same locality; and they no doubt are good specific characters, though it is a little difficult to estimate some of them with accuracy, and I am inclined to think that Wrześniowski relied a little too much on the supposed accuracy of the descriptions and figures given by other writers. It must be remembered, too, that the relative lengths of the two joints of the outer ramus of third uropoda varies in the two sexes.

In addition to these points, I have found the shape of the maxillipedes and of the more proximal joints of the gnathopoda, especially the basos and the carpus, useful points for distinguishing the British species; while the number of setæ arising from the outer margin of the dactylos is a character that may be useful for readily separating some species, such as *N. tatrensis*,

Wrześniowski. The slight differences of the two gnathopoda in the form of the carpus have hitherto received little attention.

I do not propose to enter into any points of internal anatomy, but, as the question of the degree of the degeneration of the eyes is of special interest, I may call attention to a recent paper by Vejdosky, in which he criticises the accounts previously given, and, after a careful examination by means of serial sections, comes to the conclusion that in none of the species specially dealt with is there any organ present corresponding to a normal Arthropodan eye; and that only in *N. puteanus*, Koch, is it possible to speak of a true eye-rudiment, and that even here the degeneration has gone so far that the cells of the "Augen-anlage" have been modified into a tendon-like bundle that serves to attach the large brain-ganglia to the walls of the head [34. p. 10].

The chief points by which the present species differs from other species of the genus appear to be:—

The body is slender.

The four anterior side-plates are not so deep as their segments.

The upper antennæ are not more than half the body-length.

The gnathopoda have the basos broad, the carpus not longer than the propodos, the propodos rather broader than long, the dactylos with only one seta on its convex margin and only three or four very small ones on the concave margin.

The first three segments of the pleon have the postero-inferior angle broadly rounded.

The outer branch of the third uropod has the two joints of nearly the same length in the male, and in fully-grown specimens the last joint bears only few very short setæ. (In younger males the terminal joint, though of about the same length as the first, may be more abundantly supplied with setæ, and these may be longer than is shown in Plate 16. *ur. ♂*.)

NIPHARGUS KOCHIANUS, *Spence Bate*. (Plates 16 and 17. figs. 2 & 3.)

1859. *Niphargus Kochianus*, Spence Bate, Proc. Dublin Univ. Zool. & Bot. Assoc. i. p. 239, figs. 1 and 1a; Nat. Hist. Rev. vol. vi. p. 165, fig. 1.

1859. *Niphargus Kochianus*, Hogan, Nat. Hist. Rev. vol. vi. pp. 166-169.

1861. *Niphargus Kochianus*, Hogan, Rep. Brit. Assoc. (1860) pp. 116-117.

1862. *Niphargus Kochianus*, Spence Bate, Cat. Amphip. Brit. Mus. p. 177, pl. xxxii. fig. 3.
1863. *Niphargus Kochianus*, Spence Bate & Westwood, Brit. Sessile-eyed Crust. i. p. 323.
1889. *Gammarus Kochianus*, Moniez, Rev. Biol. du Nord de la France, i. p. 48.
1890. *Niphargus Kochianus*, Wrześniowski, Zeitschrift für wissenschaftliche Zoologie, L. 4, p. 674.
1893. *Niphargus Kochianus*, Della Valle, Gammarini del Golfo di Napoli, p. 704 (*in part*).
1896. *Gammarus puteanus*, Hamann, Europäische Höhlenfauna, p. 234 (*in part*).

Specific diagnosis.—Body less slender than in *N. subterraneus*, first four side-plates as deep as their segments.

Second and third segments of pleon with posterior angles acute, that of the first rectangular.

Superior antenna about two-thirds the length of the body, slender; third joint of peduncle more than half as long as the preceding joint; flagellum containing about 16 joints, secondary appendage of two slender joints, as long as the first two joints of the main flagellum.

Inferior antenna with the last two joints of peduncle equal, rather slender; flagellum of about 8 joints, half as long again as the last joint of peduncle.

Maxillipedes with the lobes large, inner lobe reaching considerably beyond the distal end of the inner margin of the meros, and the outer lobe reaching as far as the end of the carpus.

First gnathopod shorter and rather stouter than the second; basos not specially broadened; carpus as long or longer than the propodos; propodos subquadrate, widest distally where the width is rather greater than the length; palm transverse, produced anteriorly as it approaches the inferior angle, so that this is rather less than a right angle, defined by a stout spine with a smaller one at its base; dactylos fitting closely on to the palm, convex border with only one or two setæ.

Second gnathopod slender; carpus much longer than propodos, its inferior margin not much shorter than the anterior, and supplied with five tufts of setæ; propodos as in first gnathopod, but narrower, its articulation with the carpus very narrow.

Terminal uropoda about one-fifth of the length of the body; outer branch with the first joint about four or five times as long as the peduncle, and supplied with three or four tufts of setæ;

second joint slender, one-fourth as long as the first, with a single seta at the apex.

Telson cleft for three-fourths of its length; lobes widely separated, their outer border nearly straight, with one long plumed seta, and a smaller one one-fourth from the apex, inner border slightly convex, extremity with four stout setæ.

Length about 5 mm.

Habitat. Ringwood, Hants; Warminster and Marlborough, Wilts; and Dublin. (In Europe recorded from Munich.)

This species appears to be less common than the preceding, and has consequently received less attention.

I have specimens from Marlborough and from Dublin, and have also been able to examine specimens from Munich; and though there are a few small differences that could easily be pointed out, I think these all belong to the one species. I feel pretty certain that *N. puteanus*, Hosius, from Bonn belongs to this species, and it seems not unlikely that *N. puteanus*, Koch, from Regensburg, also belongs to the same species. However this may be, it appears clear that the present species is quite a different form from *N. subterraneus*, and that it is widely distributed in Europe and the British Isles. The points by which it may be distinguished have mostly been mentioned in the brief description already given. Perhaps the most characteristic points are to be found in the gnathopoda, which have the carpus much longer in proportion to the other joints, and have the propodos articulated to it only at the distal end and lying in the same straight line as the carpus; while in *N. subterraneus* the propodos usually lies nearly at right angles to the carpus, and its articulation with it is consequently oblique and occupies part of the short inferior margin. The propodos itself is not so broad as in *N. subterraneus*, and has the inferior angle of the palm produced in a very characteristic manner, especially in the first gnathopod. The amount of this projection varies a little in different specimens, as may be seen from a comparison of figs. 2 *gn.*¹, *gn.*², and 3 *gn.*¹, *gn.*², and it appears to be greater in small specimens. Fig. 2 *gn.*¹ shows the propodos of the first gnathopod of a small specimen (4 mm. long) from Dublin, and in this the projection is very marked so that the gnathopod might almost be called imperfectly "chelate" instead of "subchelate," the inferior margin bears only two distinct transverse rows of setæ, though the third and most proximal one is represented by a single seta. The

portion of the propodos bordering the palm and its inferior angle differs from the rest of the joint in presenting a peculiar stippled and striated appearance; and it is evidently this that is represented by the shading in Spence Bate's figure in the 'Hist. Brit. Sessile-eyed Crustacea,' p. 323. This "marginate" appearance is not so marked in the larger specimen from Marlborough (see figs. 3, *gn.*¹, *gn.*²), nor in the specimens from Munich, and the tufts of setæ on the inferior margin of the propodos are more numerous. The first gnathopod is considerably shorter and rather stouter than the second; and may also be distinguished from it by the long curved seta on the meros, which is present just in the same position as in *N. subterraneus*, in which species the two gnathopoda are not so easily distinguished.

The large size of the inner and outer lobes of the maxillipedes is another point that readily separates this species from *N. subterraneus*.

The terminal uropoda do not appear to become so elongate as in *N. subterraneus*, but the specimens at my disposal are not sufficient to enable me to say how far they differ in the two sexes.

NIPHARGUS FONTANUS, Spence Bate.

1859. *Niphargus fontanus*, Spence Bate, Proc. Dublin Univ. Zool. & Bot. Assoc. i. p. 238, figs. 2 & 2 a; Nat. Hist. Rev. & Quarterly Journal of Science, vol. vi. p. 165, fig. 2.
Niphargus fontanus, Hogan, Proc. Dublin Univ. Zool. & Bot. Assoc. i. p. 240; Nat. Hist. Review, vol. vi. p. 166.
1862. *Niphargus fontanus*, Spence Bate, Cat. Amphip. Brit. Mus. p. 175, pl. xxxii. fig. 2.
1863. *Niphargus fontanus*, Spence Bate & Westwood, Brit. Sessile-eyed Crust. i. p. 319.
1889. *Gammarus fontanus*, Moniez, Rev. Biol. du Nord de la France, i. p. 48.
1890. *Niphargus fontanus*, Wrzeźniowski, Zeitschrift für wissenschaftliche Zoologie, L. 4, p. 674.
1893. *Niphargus puteanus*, Della Valle, Gammarini del Golfo di Napoli, p. 704 (*in part*).
1896. *Gammarus puteanus*, Hamann, Europäische Höhlenfauna, p. 234 (*in part*).
1896. *Niphargus fontanus*, Walker & Hornell, Jour. Mar. Zool. & Micros. vol. ii. p. 54.

Bate and Westwood describe this species as follows:—

"Moderately robust. Coxæ of the first four pairs of legs

nearly as deep as the segments to which they are attached. Gnathopoda having the propoda pear-shaped, with the palm oblique, and as long as the superior margin, which is nearly straight; inferior margin convex and posteriorly produced; palm defined by one or two movable spines. Anterior segments of the tail with the posterior angles pointed. Length $\frac{1}{2}$ inch."

I have not yet been able to examine a specimen of this species, though Bate and Westwood record it from Ringwood in Hants, Corsham in Wiltshire, and High Elms in Kent. It appears to be readily distinguished from the other British species by the pear-shaped propoda of the gnathopods and by the oblique palm. It is given by Wrześniowski as a good species.

Specimens identified by Messrs. Hornell and Sinel as *N. fontanus* have been found in two wells on the outskirts of St. Helier, Jersey, and are mentioned by Messrs. Walker and Hornell in their report on the Schizopoda &c. of the Channel Islands. I have endeavoured to trace these specimens or to obtain others from the same locality, but without success, although Mr. Hornell used his best efforts on my behalf.

Genus CRANGONYX, *Spence Bate*.

Crangonyx, Spence Bate, Proceed. Dublin Univ. Zool. & Bot. Assoc. 1859, p. 240; Nat. Hist. Review & Quarterly Journal of Science, vi. p. 165; Cat. Amph. Crust. Brit. Mus. p. 178: Bate & Westwood, Hist. Brit. Sessile-eyed Crust. i. p. 326: Della Valle, Gammarini del Golfo di Napoli, p. 681: Vejdovsky, Sitzungsberichte der Königl.-böhmischen Gesellschaft der Wissenschaften Prag Mathematisch-naturwissenschaftliche Classe, 1896, x. p. 5.

I have given above only the most important references bearing on this genus; a full historical account of it will be found in the one last given. Vejdovsky, however, has not given an amended diagnosis of the genus, and in order to avoid confusion, I shall not attempt to do so either, as that will, I presume, be done by Mr. Stebbing in his forthcoming account of the Amphipoda for 'Das Tierreich.'

It is closely allied to the genera *Paracrangonyx* and *Eucrangonyx* recently established by Mr. Stebbing. *Boruta*, Wrześniowski, is also very nearly allied to *Crangonyx*, and is indeed considered by Vejdovsky to be identical with it; while *Goplana*, Wrześniowski, is considered by him as merely a subgenus of *Crangonyx*, and the species *Goplana polonica* as a surface-species repre-

sending the form from which the subterranean species of *Crangonyx* in Europe is probably derived. Nearly allied species are found in the surface and underground waters of North America, and were formerly assigned to the genus *Crangonyx*, though most of them have now been placed in new genera by Mr. Stebbing.

- CRANGONYX SUBTERRANEUS, *Spence Bate*. (Plate 18. figs. 4.)
1859. *Crangonyx subterraneus*, Spence Bate, Proc. Dublin Univ. Zool. & Bot. Assoc. i. p. 240; Nat. Hist. Rev. vol. vi. p. 166, fig. 3.
1861. *Crangonyx subterraneus*, Hogan, Rep. British Assoc. (1860), pp. 166-169.
1862. *Crangonyx subterraneus*, Spence Bate, Cat. Amphip. Brit. Mus. p. 178, pl. xxxii. fig. 6.
1863. *Crangonyx subterraneus*, Spence Bate & Westwood, Brit. Sessile-eyed Crust. i. p. 327.
1890. *Crangonyx subterraneus*, Wrzesniowski, Zeitschrift für wissenschaftliche Zoologie, L. 4, p. 697.
1893. *Crangonyx subterraneus*, Della Valle, Gammarini del Golfo di Napoli, p. 681.
1896. *Crangonyx subterraneus*, Vejdovsky, Sitz. kgl.-böhm. Gesellschaft der Wissenschaften, 1896, x. pp. 3-32, pls. i. & ii.
1896. *Gammarus puteanus*, Hamann, Europäische Höhlenfauna, p. 234, (in part).
1899. *Eucrangonyx Vejdovskyi*, Stebbing, Trans. Linn. Soc., Zoology, ser. 2, vii. p. 423.

Specific diagnosis.—First four side-plates nearly as deep as their respective segments, the fourth much the largest, being about twice as long as the third; the lower margins of all convex and supplied with a few setæ.

Superior antennæ about one-fourth the length of the body; the flagellum of about 12 joints; secondary appendage of two slender joints, the first much longer than the second.

Inferior antennæ with the flagellum of 4 joints, the articulations between them slightly oblique.

Mandible with the palp rather broad, its second joint half as broad as long, its inner margin being produced and convex.

First gnathopod rather shorter than the second, carpus subtriangular, much shorter than the propodos: the propodos subquadrate, length of anterior border one and a half times the breadth; palm oblique, defined by a stout spine, and supplied along its length with peculiar setæ split at the ends. The second gnathopod similar, but with the anterior border of propodos twice the breadth of the joint, and the palm rather more oblique.

Basa of the last three pairs of pereiopoda broad, with the posterior margin expanded, convex, greatest breadth three-fourths of the length.

Third uropoda reaching only slightly beyond the extremity of the preceding pair; the outer branch one-jointed, twice as long as the peduncle, inner branch rudimentary, minute.

Telson reaching well beyond the end of the peduncle of the third uropod, hinder margin somewhat emarginate, lateral angles with 2 or 3 setæ.

Length about 4 mm.

Habitat. Ringwood in Hampshire, and Marlborough in Wiltshire. (In Europe recorded from Munich and Prague.)

This species was first described by Spence Bate from a single specimen found at Ringwood. From the figures given by de Rougemont [17. pl. i. figs. 1 & 2, and pl. ii. fig. 1], it appears that he really had before him either the present species or a closely allied one of *Crangonyx*; but his account of it adds nothing of importance to what was already known, and his assertion that it was merely a young stage of *Niphargus puteanus* has been already criticised by Humbert and Wrześniowski and shown to be erroneous. The species does not appear to have attracted further attention till 1896, when Vejdovsky published his important paper [21] and dealt exhaustively with its sense-organs and internal anatomy. In his revision of the Gammaridæ, Stebbing [31. p. 423] gave to the species described by Vejdovsky the new name *Eucrangonyx Vejdovskyi*, saying that it appeared to him to differ from Spence Bate's species: the points of difference to which he refers apparently being the possession of a small inner branch to the terminal uropoda and of an emargination in the telson. I have received from Mr. Stebbing a small mounted specimen of *Crangonyx subterraneus* from Marlborough, and have been able to compare it with mounted specimens of Vejdovsky's species; and after careful examination I have no doubt that both belong to the same species, and Professor Vejdovsky, who made a hasty comparison of the same specimens when I visited him in Prague in March last, was of the same opinion. In all points that can be observed the different specimens seem to be practically identical. The specimen from Marlborough is very small, and in its present mounted condition it is not possible to be quite certain whether it possesses a small inner branch to the terminal uropoda or not, though I think it has; but this

branch as figured by Vejdovsky is very small and delicate, and can no longer be seen in his specimens now that they are mounted in Canada balsam, but the rest of the uropod is so similar that I think the fine inner branch must be present in the Marlborough specimen also. In this specimen, again, the telson can be seen in side-view only, but it is evident that the two hinder angles project a little and bear setæ, as shown by Vejdovsky, and I think the posterior edge between them is slightly emarginate. In connection with this point it is perhaps worth while drawing attention to the fact that Jurinac has described considerable differences in the telson in the two sexes of his *Niphargus croaticus*, the male having the telson roundly indented (rather than cleft) for a third of its length only, while in the female the telson is sharply cleft to two-thirds of its length [37. pp. 12, 15, & 16, and pl. i. figs. 3 & 12]. In *Crangonyx mucronatus*, Forbes, again, the differences of the telson in the two sexes are quite startling; and I have recorded the fact that in *Calliopius subterraneus*, Chilton, the telson is rather more deeply emarginate in the male than in the female.

The lower antenna is shown in figure 4, *a.i.* It was wanting in Spence Bate's specimen; the articulations between the joints of the peduncle are slightly oblique, just as in *Crangonyx compactus*, Chilton.

The mouth-parts, so far as I have been able to examine them, are in minute agreement with those of the Prague specimens, the mandibles, second maxillæ, and maxillipedes being practically identical; the first maxillæ I have not seen.

The first gnathopod was described by Spence Bate as being larger than the second; and this character was made use of by Della Valle as a specific character for separating *Crangonyx subterraneus*, Bate, from *C. compactus*, Chilton. Vejdovsky has rightly shown that really the two gnathopoda differ only slightly in size, and that the second is actually the longer, though from his figures it appears that it is scarcely so stout in proportion; the same thing is true of the Marlborough specimen, as may be seen from a comparison of figs. 4, *gn.*¹ and 4, *gn.*². For an account of the peculiar split setæ on the propoda of the gnathopoda, reference must be made to Vejdovsky's paper; they are present in the Marlborough specimen, but the specimen is very small and the details of them cannot now be made out.

The large size of the fourth side-plate is a peculiar character,

and was first pointed out by Vejdovsky; the lower margins of the first four side-plates are supplied with a few setæ, each arising from a slight indentation of the margin; this has been rather exaggerated in his figure 1, so as to make it appear as if the margins were actually crenate. His fig. 3 is more correct, though even here there is rather more crenation than in the specimen.

Accessory branchiæ have been described by Vejdovsky on the last three segments of the pereion; similar appendages had previously been described by Wrześniowski in *Boruta* and *Goplana*.

BIBLIOGRAPHY.

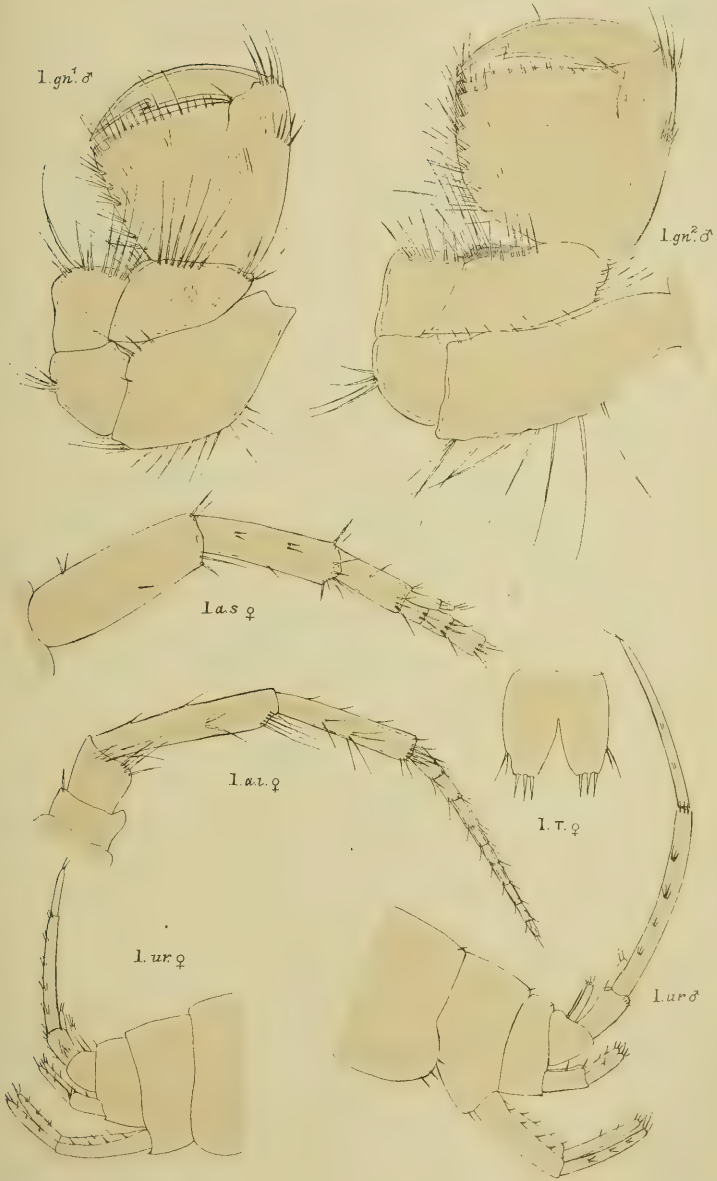
1. SPENCE BATE & WESTWOOD.—British Sessile-eyed Crustacea, vol. i., London, 1863.
2. T. R. R. STEBBING.—Report of Corresponding Societies' Committee, British Association Report, Dover, 1899.
3. W. E. LEACH.—“Crustaceology: Appendix.” The Edinburgh Encyclopædia, vol. vii. 1814, pp. 429–437.
4. P. GERVAIS.—“Note sur deux Espèces de Crevettes qui vivent aux environs de Paris.” Annales des Sciences naturelles, Zool. 2 sér. iv. (1835).
5. K. L. KOCH.—Deutschlands Crustaceen, Myriapoden und Arachniden. Regensburg, 1835–1841.
6. ROBERT CASPARY.—“*Gammarus puteanus*.” Verhandlungen des naturhist. Vereins der preussischen Rheinlande und Westfalen, 6 Jahrg., Bonn, 1849, pp. 39–48, Taf. ii.
7. AUGUST HOSIUS.—“Über die *Gammarus*-Arten der Gegend von Bonn.” Archiv für Naturgeschichte, 15 Jahrg. 1850, Bd. i. pp. 233–248, Taf. i. u. ii.
8. J. C. SCHIÖDTE.—“Bidrag til den underjordiske Fauna.” Det danske Videnskabernes-Selskabs Skrifter, 5e Raekke. Naturvidenskabelig og Mathematisk Afdeling, Bd. ii., Kjöbenhavn, 1851.
9. J. O. WESTWOOD.—Proc. Linn. Soc., No. li. p. 218 (1853).
10. ADAM WHITE.—Popular History of British Crustacea. London, 1857.
11. C. SPENCE BATE.—“On the Genus *Niphargus*.” Dublin

- University Review, vol. i. (1859) p. 237; also in Natural History Review, vol. vi. (1859) p. 163.
12. A. R. HOGAN.—“On the Habits of *Niphargus fontanus* (n. s.), *N. Kochianus* (n. s.), and *Crangonyx subterraneus* (n. g. & s.), Spence Bate.” Nat. Hist. Review, vi. 1859, pp. 166–169.
 13. C. SPENCE BATE.—Cat. Amphipoda Brit. Mus. London, 1862.
 14. S. F. HARMER.—“On the Occurrence of the ‘Well-shrimp,’ *Niphargus*, near Norwich.” Trans. Norfolk & Norwich Naturalists’ Society, vol. vi. pp. 489–491.
 15. VALETTE ST. GEORGE.—“De Gammaro puteano.” Dissertatio Inauguralis, 1857.
 16. GUSTAV JOSEPH.—“Arthropoden der Krainer Tropfsteingrotten.” Berliner entomologische Zeitschrift, Bd. xxv. 1881, Heft ii.
 17. P. DE ROUGEMONT.—Étude de la Faune des Eaux privées de Lumière. Paris, 1876.
 18. ALOIS HUMBERT.—“Description du *Niphargus puteanus*, var. *Forelii*.” Bull. de la Soc. vaudoise des Sciences naturelles, iv. (1876) pp. 278–398, pls. 6 & 7.
 19. R. MONIEZ.—“Faune des Eaux souterraines du Département du Nord.” Rev. biolog. du Nord de la France, i. (1888–1889).
 20. A. WRZEŚNIEWSKI.—Über drei unterirdische Gammariden.” Zeitschrift für wissenschaftliche Zoologie, L. 4, pp. 600–725, pls. xxviii.–xxxii.
 21. F. VEJDOVSKY.—“Ueber einige Süßwasser-Amphipoden.” Sitzungsberichte d. Kg.-böhm. Gesellschaft d. Wissenschaften, Prag, 1896, x.
 22. E. CHEVREUX.—“Sur un Amphipode d’Eau douce, *Niphargus Virei*, n. sp., provenant des grottes du Jura.” Bull. Mus. Hist. nat. Paris, 1896, no. 4.
 23. ARMAND VIRÉ.—La Faune souterraine de France. Paris, 1900.
 24. E. D. COPE.—“On the Wyandotte Cave and its Fauna.” American Naturalist, vi. July 1872, pp. 1–17.
 25. A. S. PACKARD.—“The Cave Fauna of North America.” Nat. Academy of Sciences, iv., First Memoir.
 26. J. E. BENEDICT.—“Preliminary description of a new Genus

- and three new Species of Crustaceans from an Artesian Well at San Marcos, Texas." Proc. U.S. Nat. Mus. xviii. No. 1087.
27. S. A. FORBES.—"List of Illinois Crustacea." Bull. Illinois Mus. Nat. Hist. i: 6 (1876).
28. C. CHILTON.—The Subterranean Crustacea of New Zealand." Trans. Linn. Soc., 2nd ser. Zoology, vi. part 2.
29. G. M. THOMSON.—"Note on Tasmanian Crustacea." Proc. Roy. Soc. Tasmania, 1892.
30. O. A. SAYCE.—"On a new Species of *Niphargus* from Australia." Proc. Roy. Soc. Victoria, xii. pt. ii.
31. T. R. R. STEBBING.—"Amphipoda from the Copenhagen Museum and other sources," Part ii. Trans. Linn. Soc., 2nd ser. Zool. vii. part 8 (1899).
32. DELLA VALLE.—"Gammarini del Golfo di Napoli." Fauna & Flora, Monograph xx. (1893).
33. O. HAMANN.—Europäische Höhlenfauna. Jena, 1896.
34. F. VEJDOVSKY.—"Ueber einige Süßwasser-Amphipoden, II. Zur Frage der Augenrudimente von *Niphargus*." Sitzungsberichte d. Kg.-böhm. Gesellschaft der Wissenschaften, Prag, 1900.
35. A. S. PACKARD.—"On the Origin of the Subterranean Fauna of North America." American Naturalist, xxviii. pp. 727-751.
36. G. H. CARPENTER.—"Animals found in the Mitchelstown Cave." Irish Naturalist, iv. pp. 25-35.
37. A. E. JURINAC.—"Ein Beitrag zur Kenntniss der Fauna des Kroatischen Karstes und seiner unterirdischen Höhlen." Inaugural Dissertation, München, 1888.

EXPLANATION OF THE PLATES.

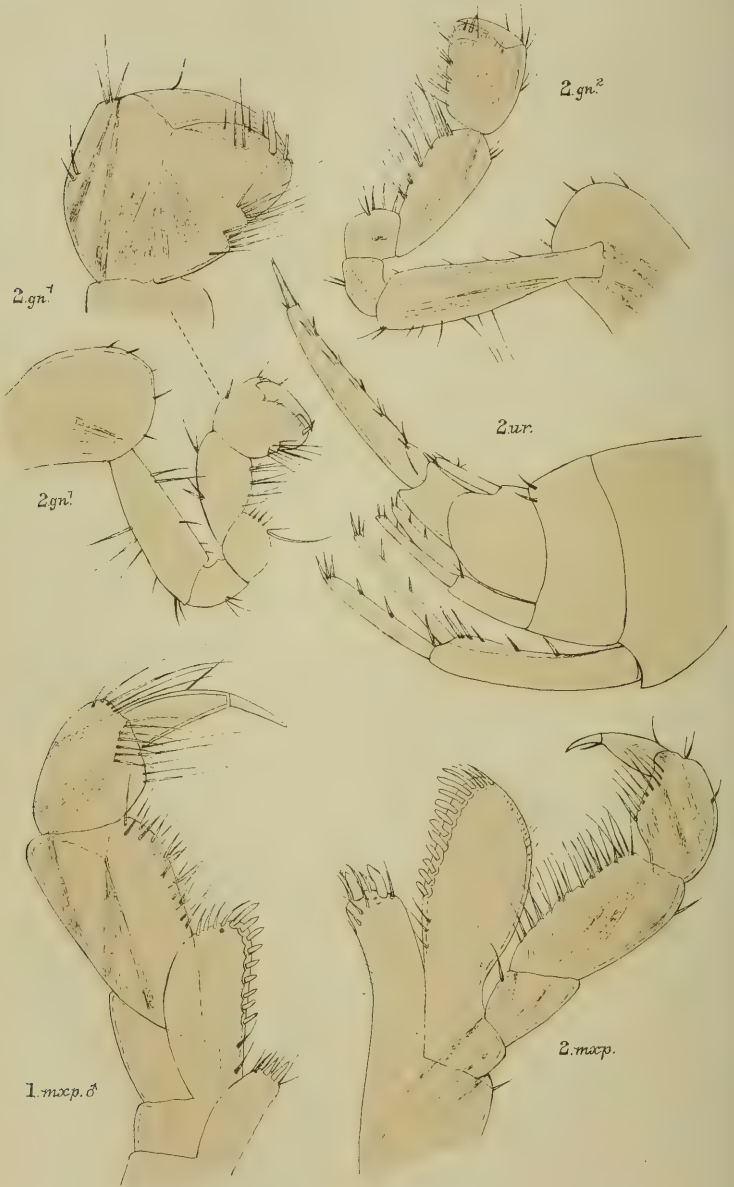
- a.s.* = superior antenna.
a.i. = inferior antenna.
md. = mandible.
mxp. = maxillipede.
*gn.*¹ = first gnathopod.
*gn.*² = second gnathopod.
*prp.*³ = first pereopod.
ur. = terminal portion of pleon with uropoda.
T. = telson.



C. Chilton del.
M. P. Parker lith.

Geo. West & Sons imp.

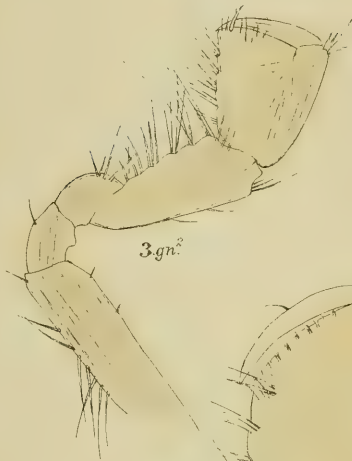
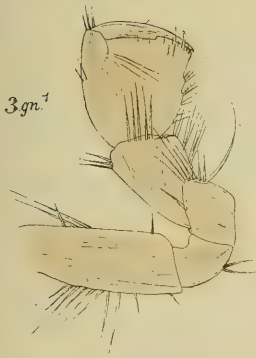
1. NIPHARGUS SUBTERRANEUS, Leach.



C. Chilton del.
M.P. Parker lith.

Geo. West & Sons imp.

1. NIPHARGUS SUBTERRANEUS, Leach.
2. " KOCHIANUS, Spence Bate.



2. T.

PLATE 16.

Fig. 1. *Niphargus subterraneus*, Leach. The sex of the specimen from which each drawing was made is indicated by the usual sign.

PLATE 17.

Fig. 1. *Niphargus subterraneus*, Leach.

2. *Niphargus Kochianus*, Spence Bate, drawn from a specimen from Dublin.

PLATE 18.

Fig. 2. *Niphargus Kochianus*, Spence Bate, Dublin specimen.

3. Ditto, from a Marlborough specimen.

4. *Crangonyx subterraneus*, Spence Bate.

(All the figures considerably magnified.)
